NOAA PROFILER
MONITOR AND DISPLAY STATION (MDS)
Version 3.2

Users Guide

May 1999

Overview

The NOAA Profiler Monitor Display Station (MDS) is a Windows 3.1/95/98 based application designed to capture, archive, and display profiler, surface meteorological, and RASS data produced by the profiler system. The MDS is a diagnostic tool that can be used by field maintenance personnel to view and analyze large amounts of data in graphical and text format. The MDS functions in a listen-only mode, passively acquiring 6-minute data via RS-232 from the Data Processor Port B3 and then saving the data to disk.

System Requirements

- Windows 3.1 or Windows95/98
- 3 Megabytes of free disk space for the application and support files
- 3+ Megabytes free disk space to save data files
- 1 RS-232 serial port for data acquisition
- 1 RS-232 Null-Modem Cable
- Color Display (recommended) with 256 color capability
- Pointing Device

Software Installation

To install the MDS software on your computer, perform the following steps:

1. Create a folder named **C:\MDS**, or choose another name if you so desire.

2. Create a sub-folder subordinate to the folder created in step 1 named **Data6** (C:\MDS\DATA6). It is mandatory that this subordinate folder be named “Data6”. The “Data6” folder his used by the MDS program to save and retrieve 6-minute data files.

3. Place the following files in the folder created in step 1 (C:\MDS):

MDS.EXE	(the MDS Executable file)
BC450RTL.DLL	(Borland support DLL)
BIDS45.DLL	(Borland support DLL)
OWL252.DLL	(Borland support DLL)
SE_NAMES.404	(Text file containing Significant Event Names for 404 MHz systems)
SE_NAMES.449	(Text file containing Significant Event Names for 449 MHz systems)

4. Optionally, create a shortcut for the MDS executable. The MDS program is now ready for use via the shortcut, or can be executed from the Windows Explorer.

The first time the MDS program is executed, a Dialog box will appear on the screen stating that the program has not yet been configured. For information about configuring the MDS see the section titled **Program Configuration Settings Dialog**.

Hardware Setup

The MDS interfaces with the profiler system using the *DP Interface* connector located on the front panel of the Equipment Cabinet below the Status Monitor. The DP Interface gender is DTE and the connector style is a DB-25 pin male. The interface cable must be a Null-Modem with the minimum RS-232 signals TX Data (pin 2), RX Data (pin 3), and Signal Ground (pin 7).

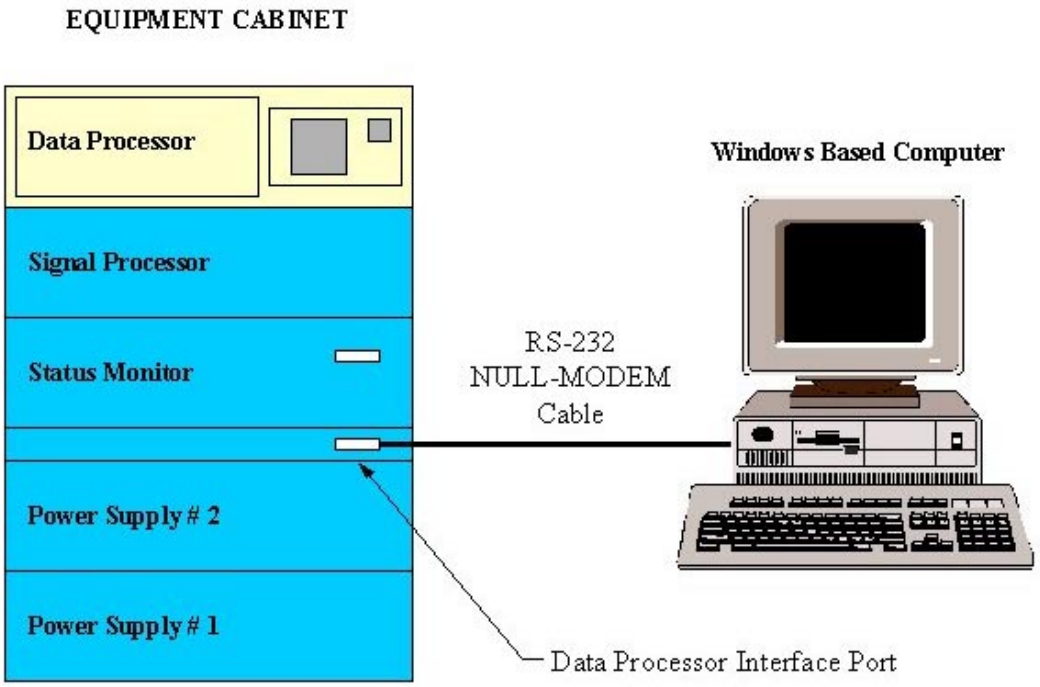


Figure 1 MDS RS-232 Interface Connections

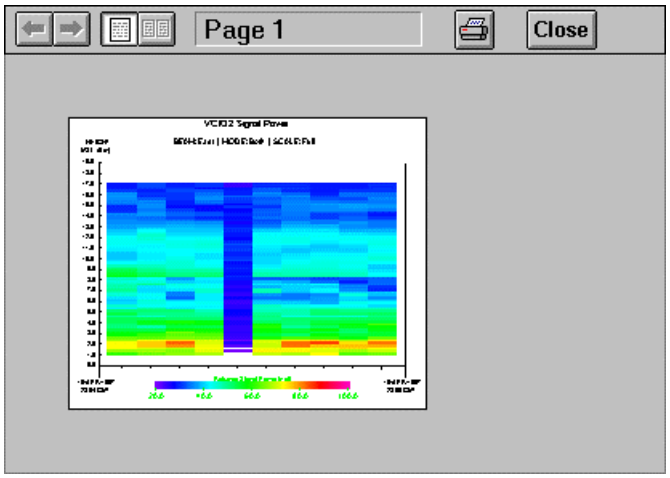
Program Menu Options

The MDS user interface is driven by menu commands and Dialog boxes. This section describes the function of the menu commands and the operation of the dialog boxes.

File

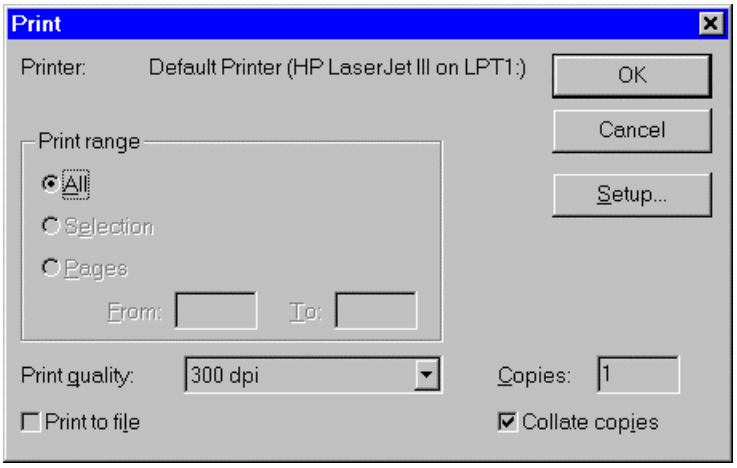
Print Preview

Allows the user to preview the current display prior to printing a hard copy.



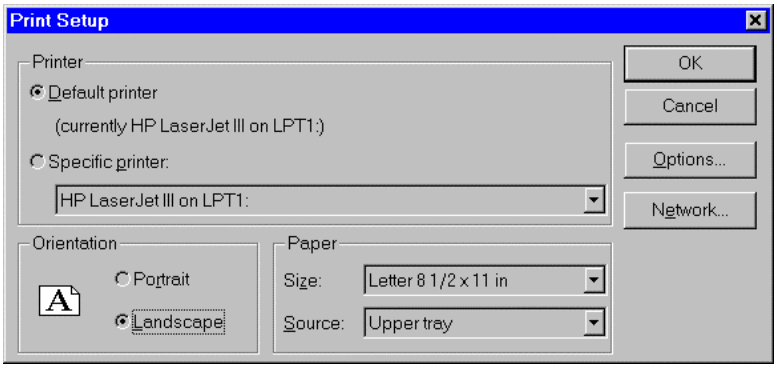
Print

Opens the print dialog box.



Print Setup

Allows the user to select printing devices and set printing options.



Config...

Opens the MDS Program Configuration Dialog box. See **Program Configuration Settings Dialog** for more information about this dialog box.

Colors…

Opens the MDS Color Configuration Dialog box. See **Program Color Settings Dialog** for more information about this dialog box.

Settings...

Open the MDS Display Settings Dialog box. See **Display Settings Dialog** for more information about this dialog box.

Next Page

Allows the user to move to the next page of a multi-page display or text-based display. This menu option is automatically disabled if the selected display has only one page. Paging is circular, when the last page is reached the next selection rolls back to the first page.

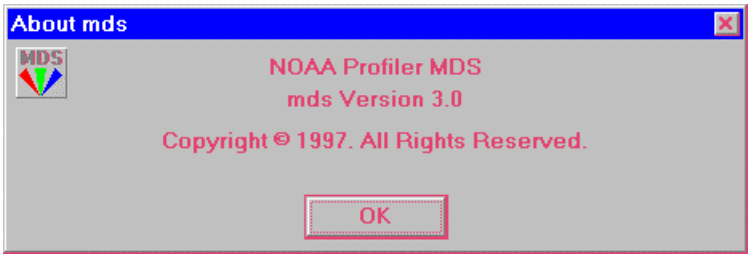
Prev Page

Allows the user to move to the previous page of a multi-page display or text-based display. This menu option is automatically disabled if the selected display has only one page. Paging is circular, when the first page is reached the next selection rolls back to the last page.

Help

About...

Displays the About Dialog Box.

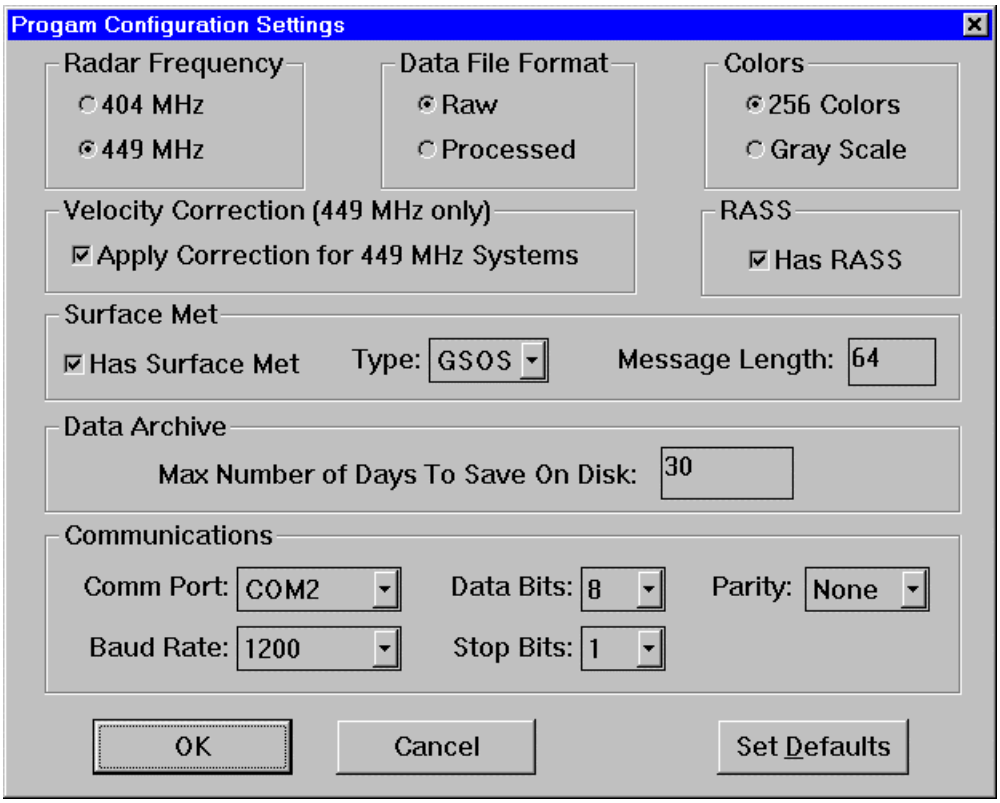


Help Read Me...

Opens Windows Write or WordPad and displays this document.

Program Configuration Settings Dialog

The Program Configuration Dialog Box allows the user to configure the MDS to adapt to all the hardware and firmware variations that are currently used at 404 and 449 MHz profiler sites. The selections made using this dialog become the current and default start-up setting for the MDS. The Program Configuration Settings dialog box is show below.



Radar Frequency

The MDS Program can be used with a NOAA 404 MHz profiler or a NOAA 449 MHz profiler with Data Processor Firmware Versions 6 or lower.

Data File Format

Determines the format that data is saved and read from disk. The *Raw* option is used to save data in that same format it is received from the profiler system. The *Raw* file format uses less disk space than the *Processed* option, but is slower to retrieve data from disk since each data file must be decoded as it is read from disk. The *Processed* option uses more disk space to save data files, but retrieves data files from disk much faster than the Raw file format.

Colors

Color spectrums are used to graphically display Signal Power, Radial Velocity, Velocity Variance, and Clutter Flags. A 256-color spectrum or 64 shades of gray spectrum can be selected. If the color spectrum is changed, the MDS program must be exited and restarted before the new color spectrum takes effect.

Velocity Correction *(449 MHz Systems Only)*

This option must be selected if the profiler is a 449 MHz system and the firmware version of the profiler Data Processor is version "6" or less. This option properly scales the Nyquist Interval for Diagnostic Spectra and Radial Velocity displays.

Has RASS

Select this option if the profiler is equipped with RASS and Data Processor firmware version supports RASS processing.

Surface Met

Has Surface Met

Select this option if the profiler is equipped with a surface meteorological package. The MDS program supports data formats for Profiler Surface Observing Systems (PSOS) or G.P.S. Surface Observing Systems (GSOS).

Type

Select the PSOS option if the profiler is equipped with a MARS surface met package. Select GSOS if the profiler is equipped with GPS surface met package.

Message Length

The Message Length determines the number of bytes to expect from the surface met package. This number can range from 2 to 512 and must be an even number. Version 3.0 MDS software only understands PSOS or GSOS data formats. The message length for these two systems is shown below.

PSOS block length = 36 bytes
GSOS block length = 64 bytes

Data Archive

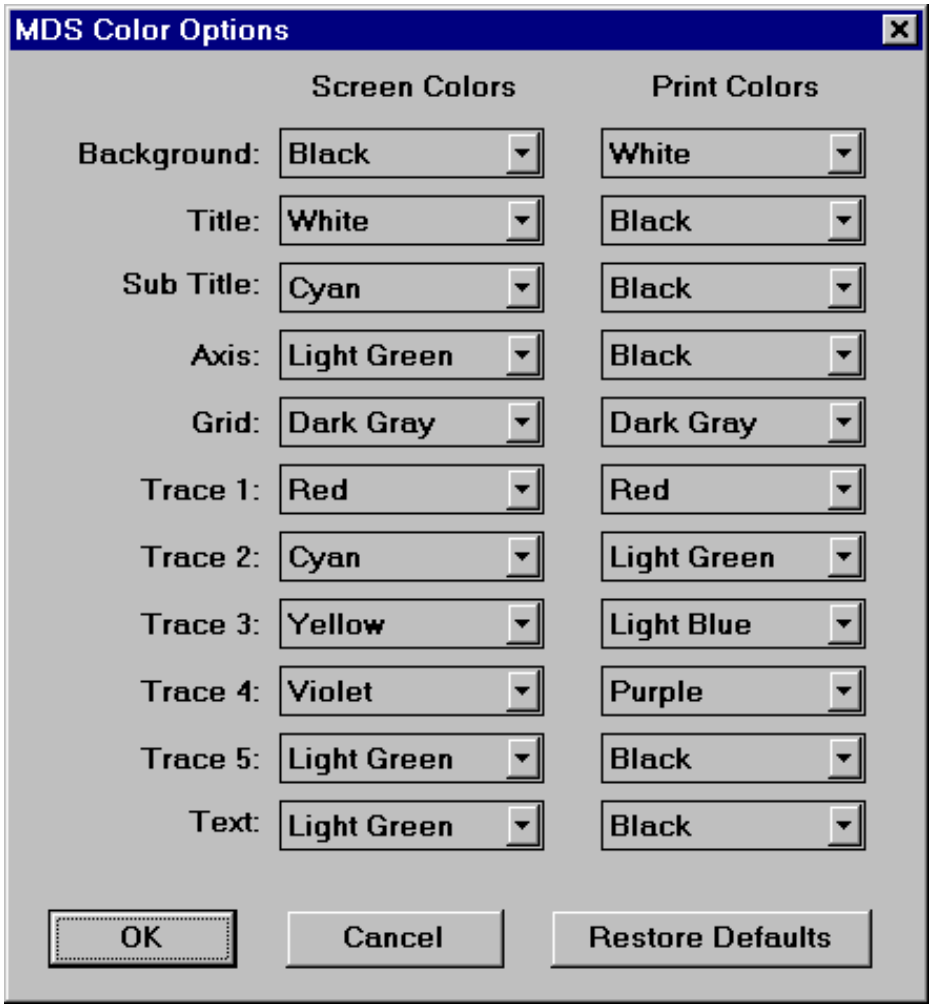
This option determines how much historical data will be saved on disk. Each time new data is received from the profiler system, the MDS will examine the date and time of the data, and delete any data file that is older and the latest data minus X number of days. This allows an unattended MDS to collect data from the profiler continuously without filling-up the hard disk.

Communications

These options set the serial communications parameters for the program. These parameters must match and settings used for the profiler Data Processor landline port. The default communications settings for the profiler Data Processor are 1200 baud, 8 data bits, 1 stop bit, and even parity.

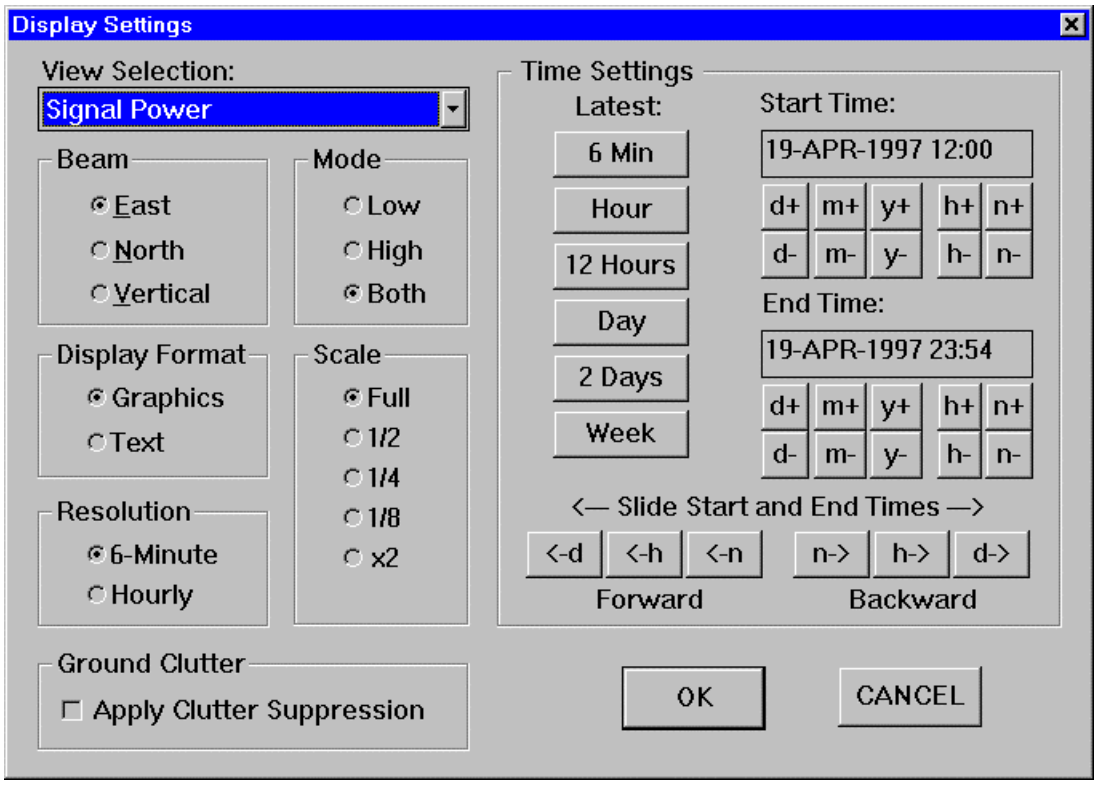
Color Settings Dialog

The MDS Color Options Dialog allows the user to customize the colors for the display and printout. Color selections are saved to disk (COLORS.CFG) and become the defaults for the MDS displays. When the screen background color is changed while the MDS is running, the display must be re-displayed twice before the background color change takes effect. Clicking the Restore Defaults button can restore the factory default color scheme. The format of the MDS Color Options Dialog box is shown below.



Display Settings Dialog

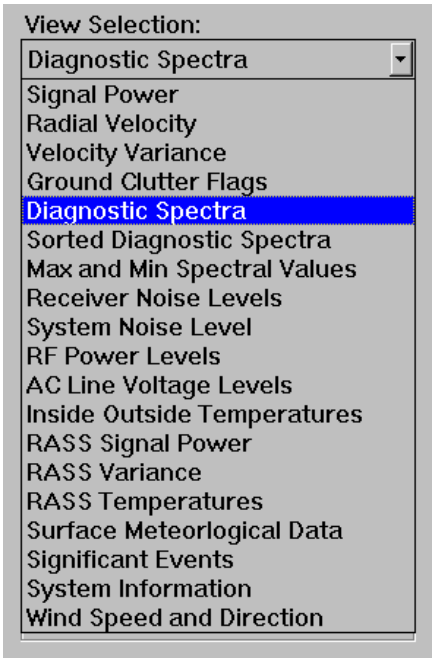
The Display Setting Dialog allows the user to select the display type, format, and time range for the MDS displays. The format of the Display Setting Dialog is shown below. After the desired settings have been made, clicking the OK button cause the MDS to display the new view.



View Selection

The View Selection Combo Box selects the view that is displayed on the screen. The number of available View selections is determined by the settings used in the Configuration Dialog Box.

At this time, 449 MHz profilers using Data Processor firmware version 6 or less, do not provide Amplifier Forward Power, Driver Power, or AC Line Voltage information.



Beam

The Beam Select Radio Buttons determine which beam (East, North, or Vertical) will be used for Signal Power, Radial Velocity, Velocity Variance, Clutter Flags, and Receiver Noise Level displays.

Mode

The Mode Select Radio Buttons determine which mode (Low, High, or Both) will be used for Signal Power, Radial Velocity, Velocity Variance, Clutter Flags, and Receiver Noise Level displays.

Scale

The Scale Select Radio Buttons determine the maximum scale used to display Signal Power, Radial Velocity, Velocity Variance, Clutter Flags, RASS Signal Power, RASS Velocity Variance, and RASS Temperatures. These controls are useful for enhancing small-scale variations of the data.

Display Format

Data can be displayed in graphic or text format. Graphical displays can display any time selection spanning 6 minutes to 1 week. Text displays show only one 6-minute period of data per page. Use the *Next Page* and *Prev Page* menu options to scroll through data periods.

Resolution

At this time, only 6-minute data can be displayed using MDS Version 3.0.

Ground Clutter

Clutter suppression is an algorithm to suppress signal returns from stationary hard-targets such as mountain ranges, antenna towers, and trees. Such targets can cause large spikes in the spectra at zero velocity. This option only applies to *Diagnostic Spectra* displays. It allows the user to view the spectra pre- and post- ground clutter suppression. Spectral moments are always calculated from post-clutter suppression spectra.

Time Settings

Latest (data selection buttons)

Allows the user to select the latest available data with minimal typing. The latest data is derived from the newest data file that has been written to disk.

Slide Start and End Times

Moves the start and end times forward or backward in time, keeping the difference between the start and end times equal.

Start and End Time Edit Boxes

Displays the starting time for the plot. The edit box will respond to both key strokes and mouse selections. The starting time for a plot must less than or equal to the ending time. The value for minutes must fall on a 6-minute boundary (00, 06, 12, 18, 24, 30, 36, 42, 48, 54) The date format used for the time is:

dd-mmm-yyyy hh:nn

where: dd = day 01 - 31

mmm = month (JAN, FEB, MAR, APR, MAY, JUN, JUL,.....)
yyyyy = year 1970 - 2020
hh = hour 00 - 23
nn = minute 00 - 54

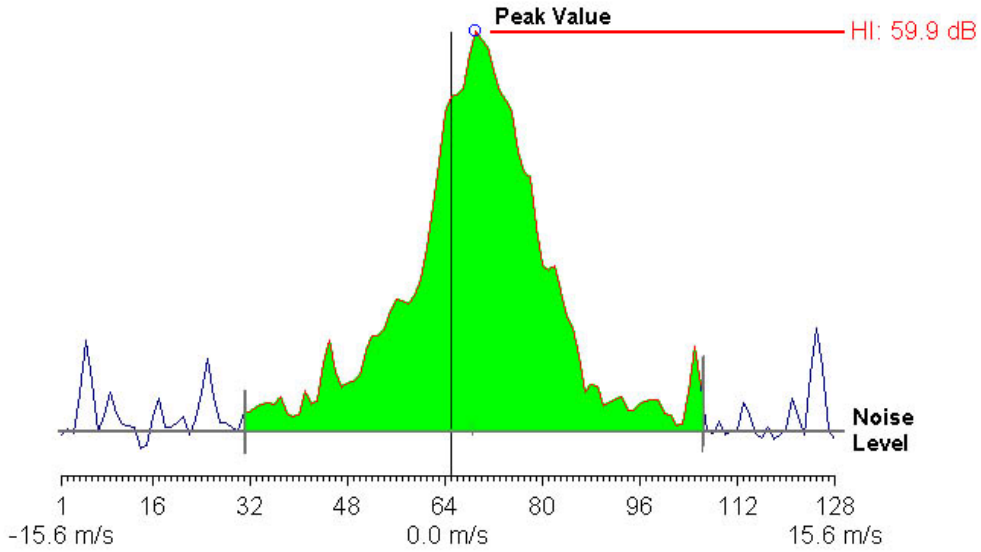
Increment & Decrement Buttons

d+ d- : Change day values
m+ m- : Change month values
y+ y- : Change year values
h+ h- : Change hour values
n+ n- : Change minute values

Display Types

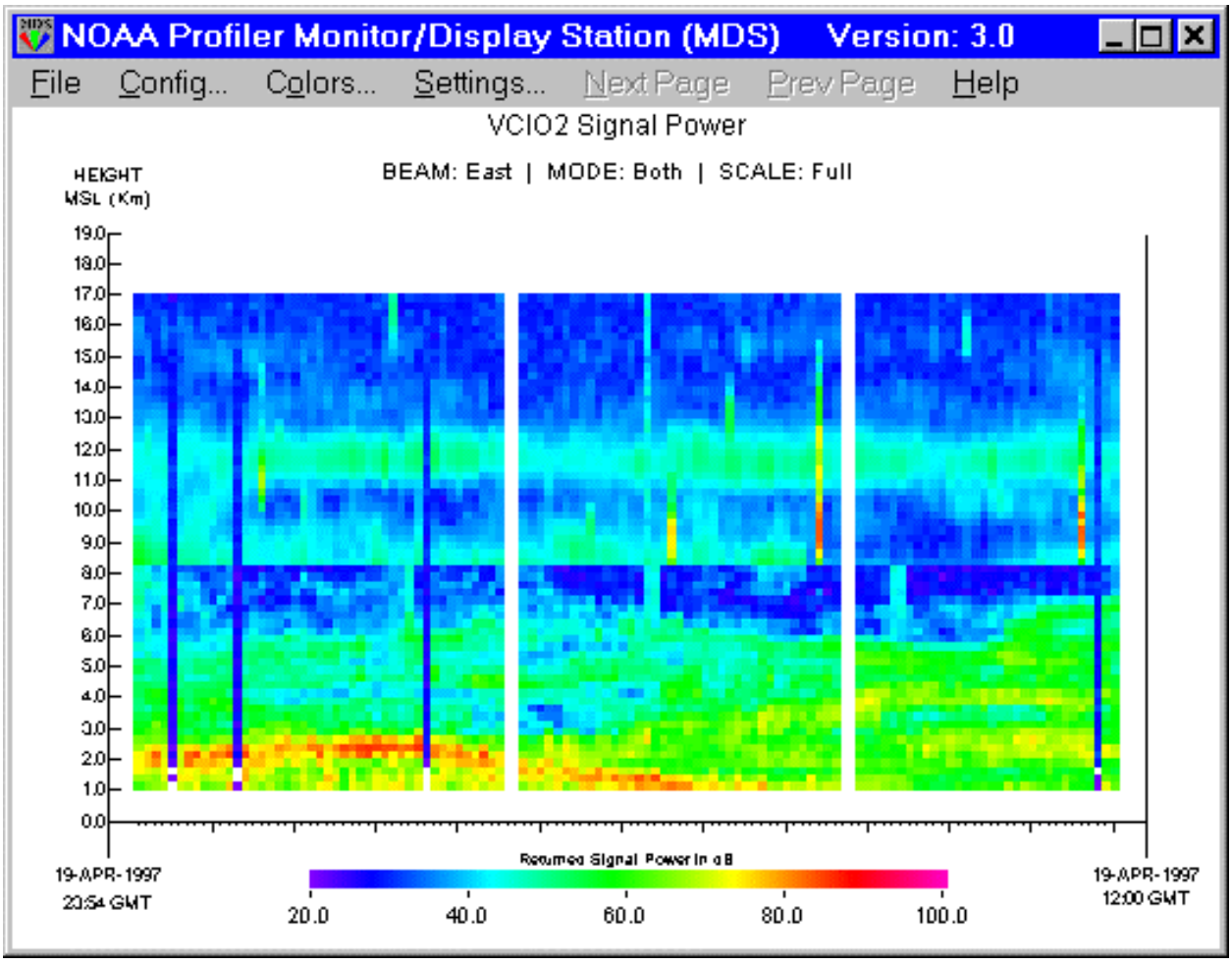
Signal Power

Signal Power, referred to as the 0th moment, is the measure of the strength of atmospheric signal returns. The Signal Power for a single range gate is derived from the range gates' diagnostic spectrum. It is calculated by locating the peak of the spectrum and summing the power values of the points within the 128 point spectrum that are above the spectral noise level (left and right of the spectral peak). The following is a graphic representation of signal power calculation. The green area shows the spectral points (from bin 31 to bin 105) that would be used to calculate the signal power for this spectrum.



I

In the following example, twelve hours of 6-minute data are plotted showing both low and high mode signal powers for the east beam. A colored cell on the screen represents the Signal Power for each range gate. The strength of signal returns is represented by the color spectrum. Blue colored cells indicate weak signal returns (20 - 40 dB), green colored cells indicate greater signal returns ranging from 40 dB to 80 dB, and so on. It is typical to have high signal power in the low range gates of the low and high modes, and weak signal returns in the highest gates. The dark blue vertical stripes in the data occur when the transmitter is inhibited by a SARSAT turn-off period. The white vertical stripes in the data occur when a 6-minute data period is missing, usually caused when the profiler reboots and fails to send its message. The distinct horizontal line at ~8 km results because the lowest 8 range gates of the high mode overlaps the highest 8 range gates of the low mode.

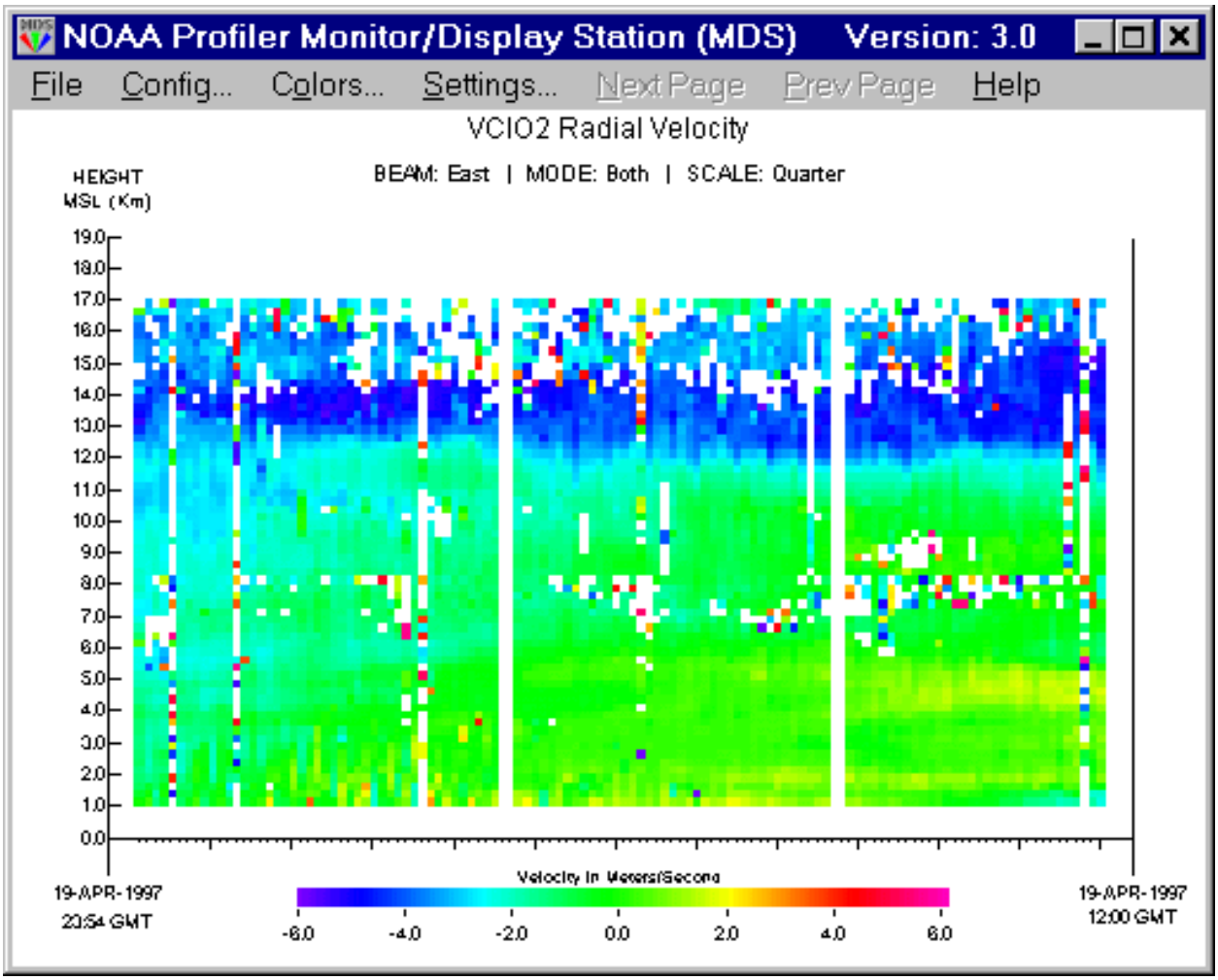


Radial Velocity

Radial Velocity, referred to as the 1st moment, represents the Doppler shift of the atmospheric signal returns. Radial Velocity for a single range gate is derived from the range gates' diagnostic spectrum. The Radial Velocity represents the centroid of bins that comprise the range gates' Signal Power calculation.

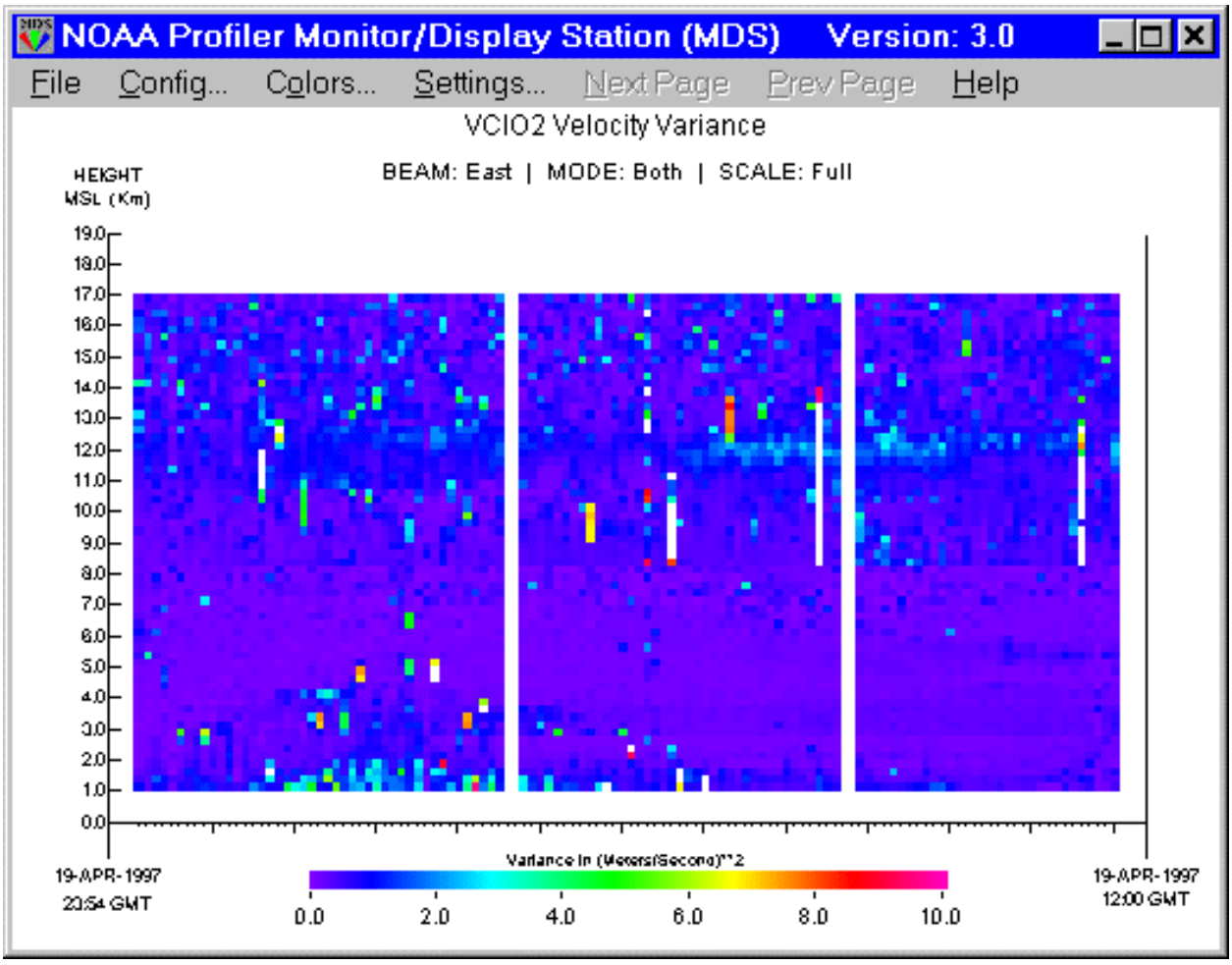
In the following example, twelve hours of 6-minute data are plotted showing both low and high mode radial velocities for the east beam. A colored cell on the screen represents the Radial Velocity for each range gate. The amount of Doppler shift of signal returns is represented by the color spectrum. Blue colored cells indicate negative Doppler shifts (out-going signals), green colored cells indicate little of no Doppler shift, and red colored cells indicate positive Doppler shifts (in-coming signals). The scale of this plot was decreased to enhance this plot was

It is typical to have high signal power in the low range gates of the low and high modes, and weak signal returns in the highest gates. The dark blue vertical stripes in the data occur when the transmitter is inhibited by a SARSAT turn-off period. The white vertical stripes in the data occur when a 6-minute data period is missing, usually caused when the profiler reboots and fails to send its message. The distinct horizontal line at ~8 km results because the lowest 8 range gates of the high mode overlaps the highest 8 range gates of the low mode.



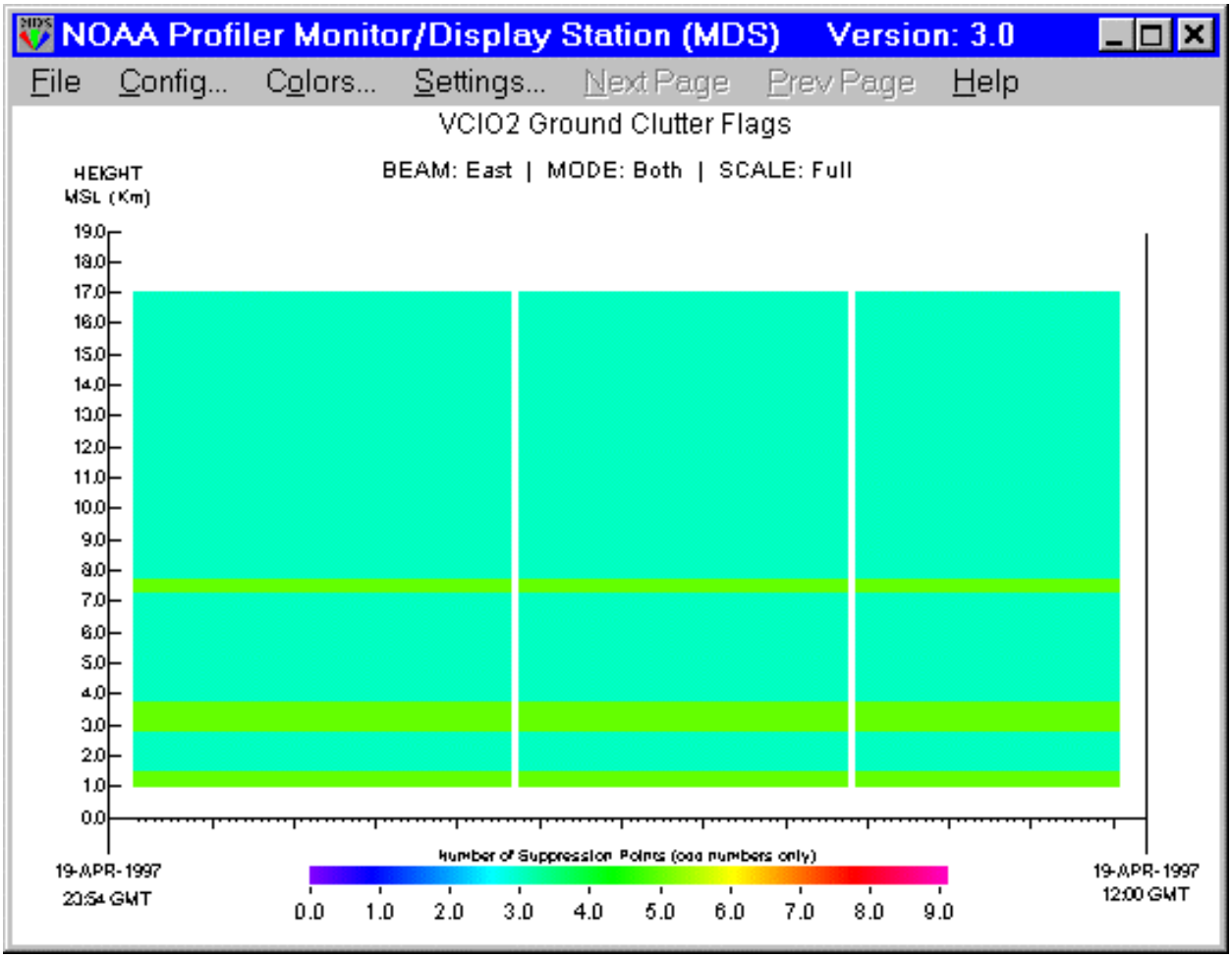
Velocity Variance

Velocity Variance, referred to as the 2nd moment, represents the spectral width of the atmospheric return signals. Velocity Variance is expressed in **(meters/second)^2.** Normally, spectral widths are narrow (less than (2 meters/second)^2. However storm conditions with heavy rain or an airplane in an antenna side lobe can cause the spectral widths to widen significantly. In the example below, note the small vertical patches of white are caused by variance values that are outside of the maximum plot range. The larger white vertical stripes are cause by missing six-minute data periods.



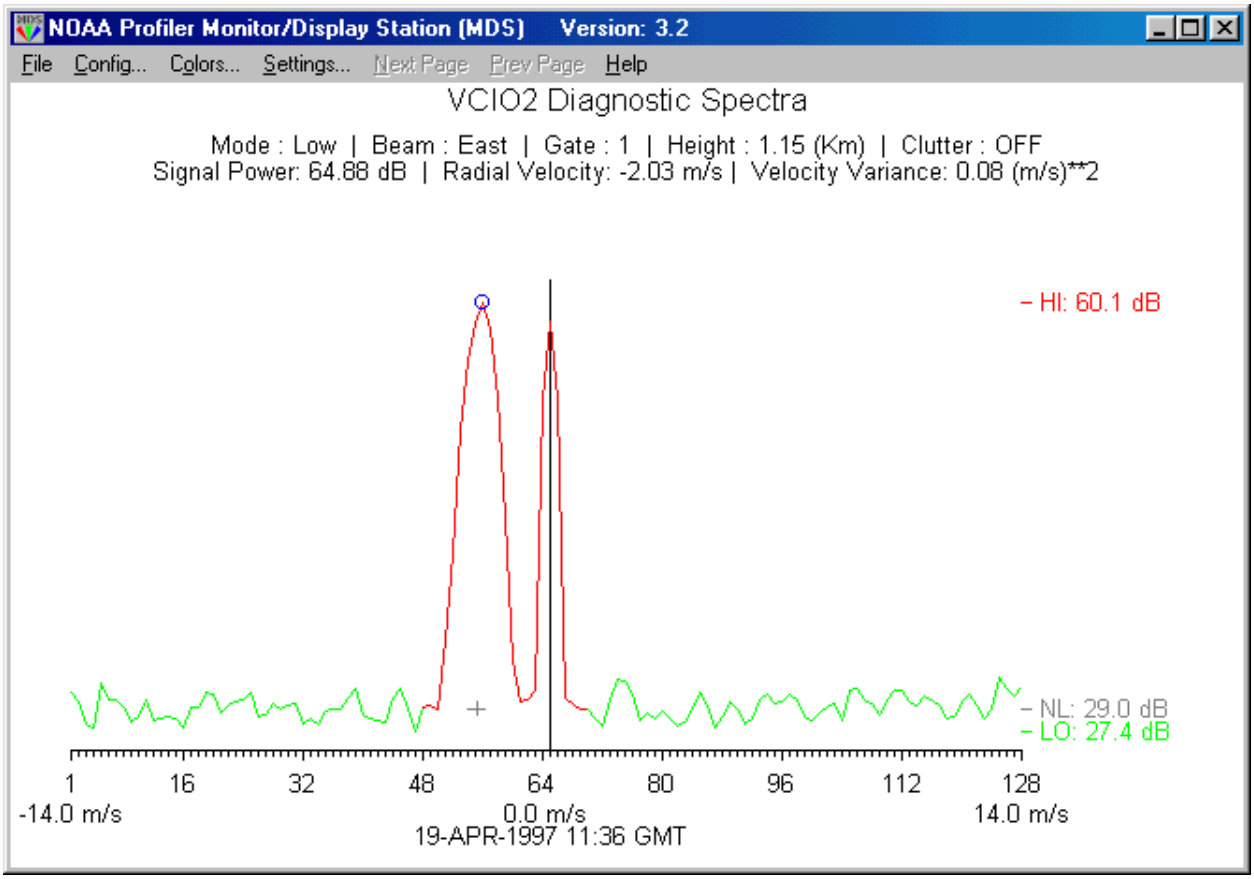
Ground Clutter Flags

Ground Clutter is caused by signal returns bouncing off of fixed non-moving targets such as towers or mountain ranges. These signal returns have no Doppler shift, and as a result, produce a spike in the diagnostic spectra at the center frequency. This clutter spike in the spectra can sometimes overwhelm weak atmospheric signal returns, causing the radar to produce incorrect velocity estimates. The most common approach to eliminating clutter is to apply a clutter suppression algorithm to the raw spectral data. The FFT contains 128 points, centered at bin 65, by suppressing the amplitude of the spectral values at bin 64 and several adjacent bins on either side of bin 64, a ground clutter spike can effectively be removed. Clutter flag values range from 1-, 3-, 5-, 7-, or 9-point (or bins). The most common value is 3-point suppression, applied to bins 64,**65**,and 66. The maximum clutter flag value of 9 point suppression applies to bins 61,62,63 64, **65,** 66, 67, 68, and 69. Clutter suppression works well, as long as the true atmospheric signals have some Doppler shift. Large clutter suppression values can have undesirable affects when the true atmospheric signal returns are centered at zero velocities. The example Clutter Flag Display below shows a graphic representation of the range gates having either 3-point or 5-point clutter suppression values.



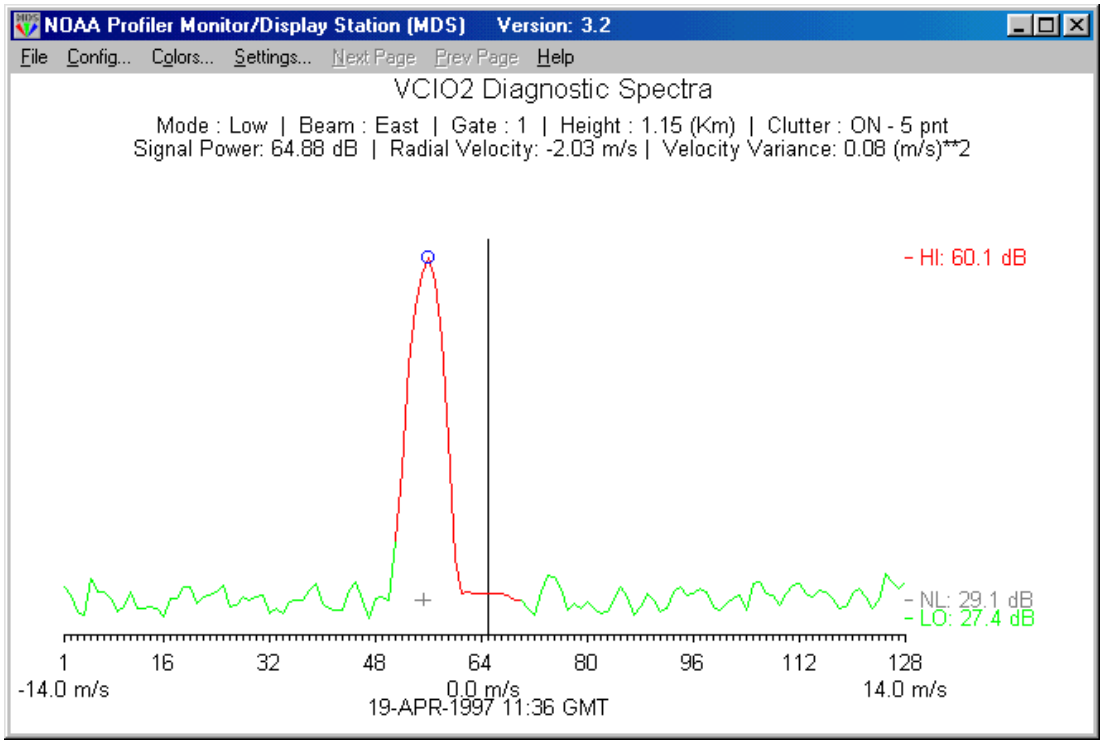
Diagnostic Spectra

Diagnostic Spectra represent the raw spectral data generated for each and every range gate. Although the radar does the same spectral processing for each of 216 range gates internally, due to bandwidth limitations the radar only transmits raw spectral data from one range gate every six minutes. The display below represents one 6-minute sample collected for a single range gate. This spectra is shown before the ground clutter spike has been removed (note the narrow spike at bin 65.) The peak value of the true atmospheric signal is marked using the blue circle. All bins in the spectra that comprise the Signal Power estimate are marked using red lines. The Radial Velocity (Doppler shift) of the spectra is estimated by finding the centroid of the signal power region (after clutter spike is removed). Velocity Variance is derived from the width of the bins comprising the signal power region.

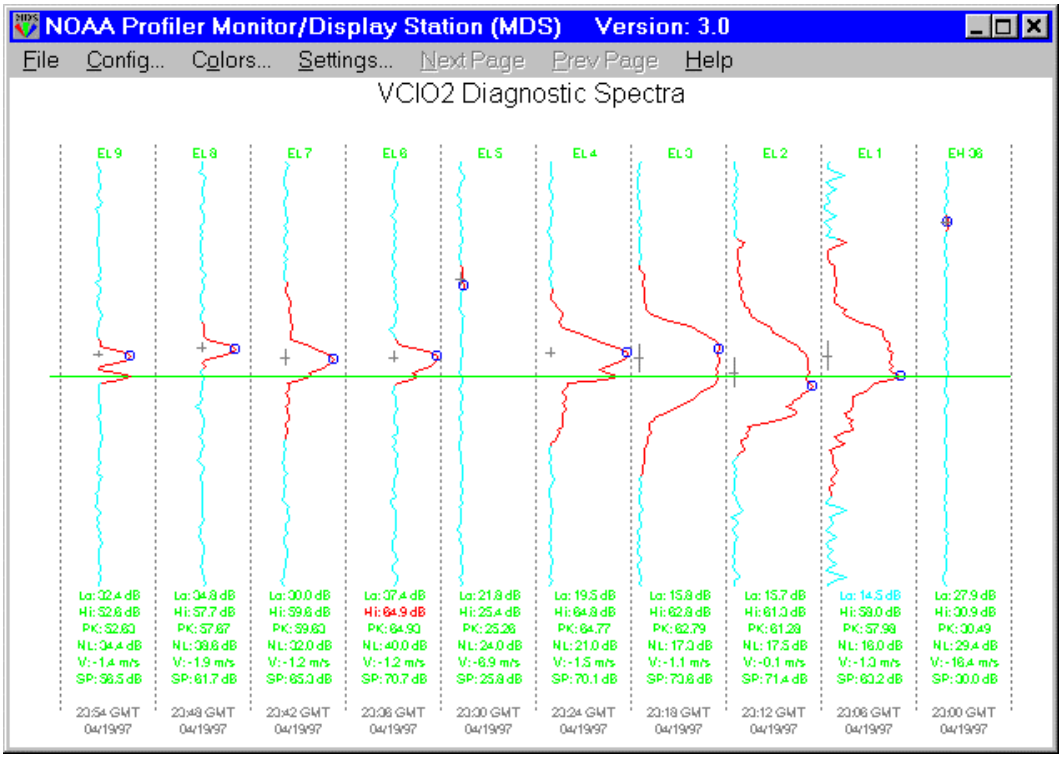


Configuration parameters determine how the radar reports diagnostic spectra. Normally the radar steps sequentially through range gates starting in the East beam, High mode, Gate 1 progressing to range gate 36, then switches to East beam Low mode Gate 1 until all beam, modes and gates have been traversed. If the radar should happen to reboot before the entire cycle is completed, the order will restart at East High Gate1. Optionally, the radar's configuration parameters can be modified to instruct the radar to transmit the spectral data from a single range gate every six minutes.

The figure below is the same spectral data as shown in the previous figure, except the spectra is shown after the ground clutter spike has been suppressed.

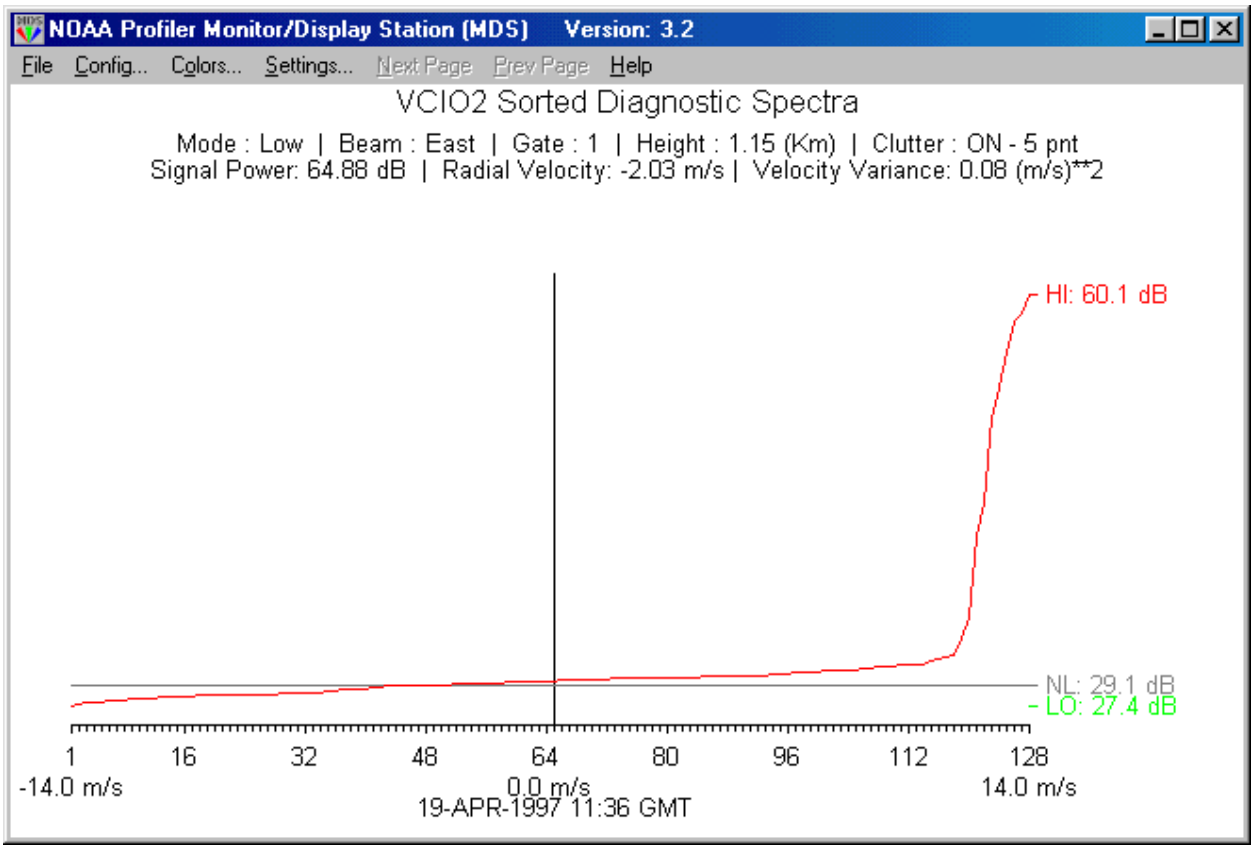


The display shown below is and example of one hour of spectral data collected from 10 sequential range gates.



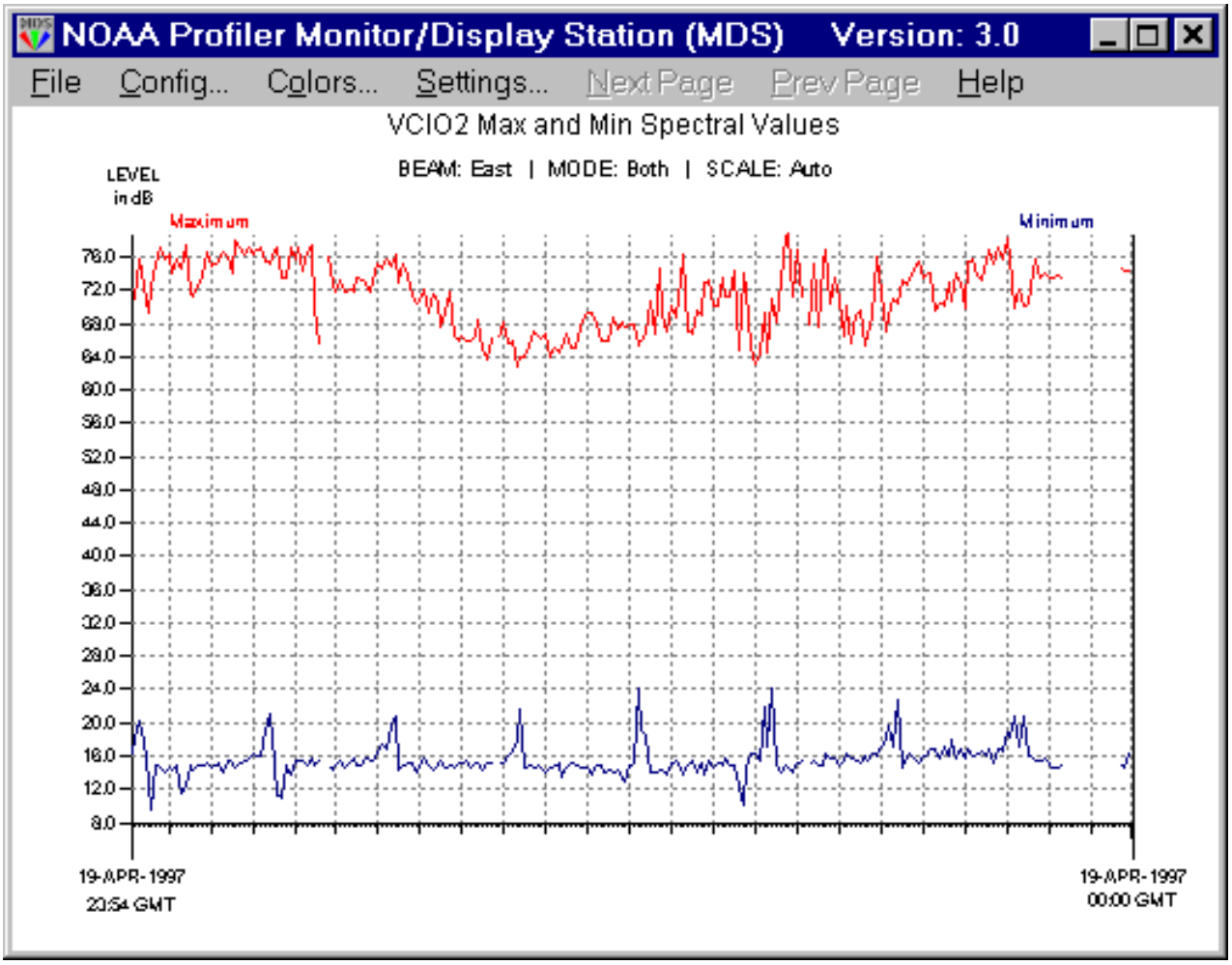
Sorted Diagnostic Spectra

The figure below shows a single diagnostic spectrum with its spectral values sorted in ascending order. The display has no real interpretive value other than demonstrating how the radar's algorithm calculates the noise level for a spectra. The algorithm seeks the mid-point of the linear region of the sorted spectral values. Once the noise level has been determined the radar used this value as the cut-off points for determining the boundaries for the signal power estimate.

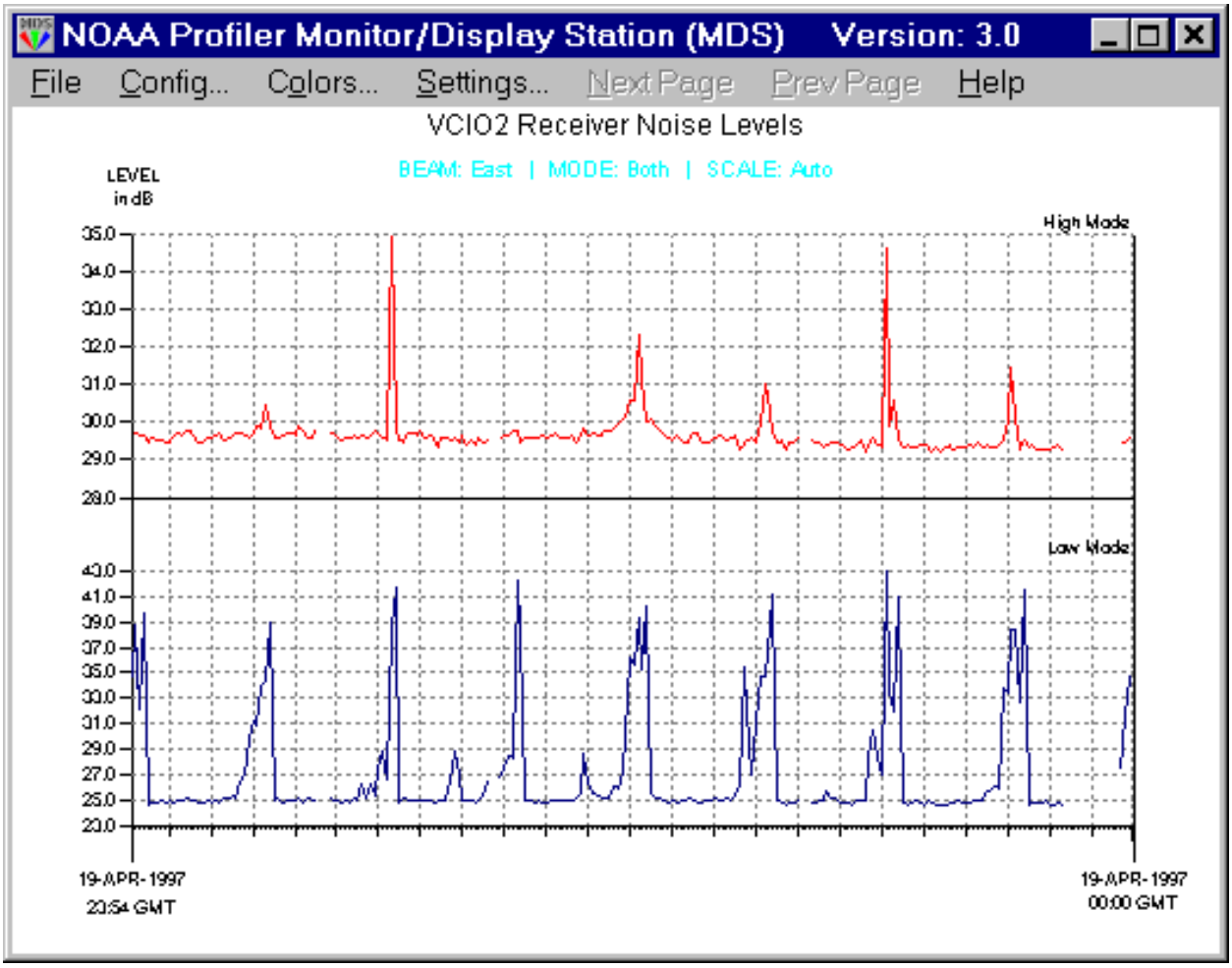


Maximum and Minimum Spectral Values

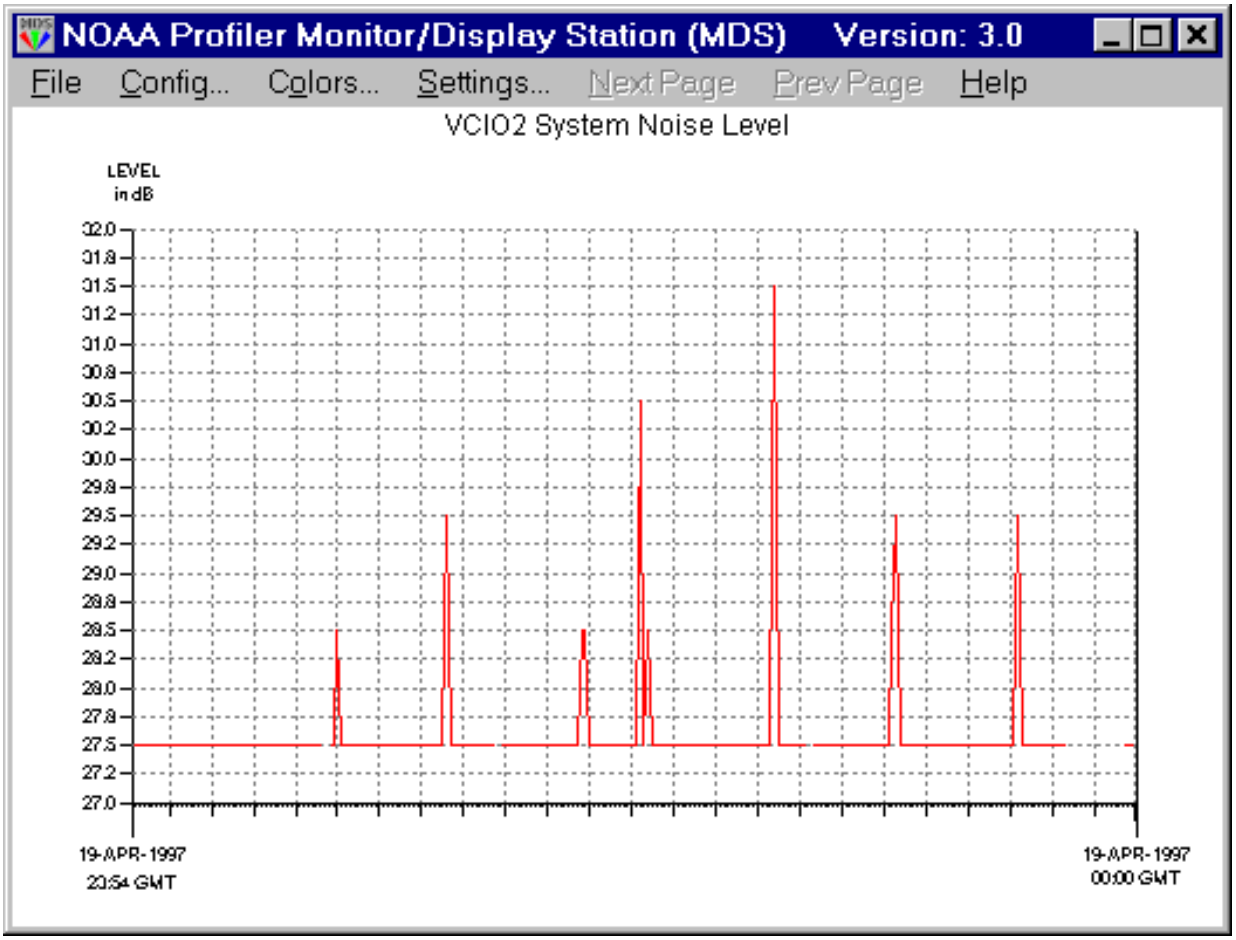
The radar records the maximum and minimum spectral values for each beam (east, north, and vertical). The figure below is a time series of these values



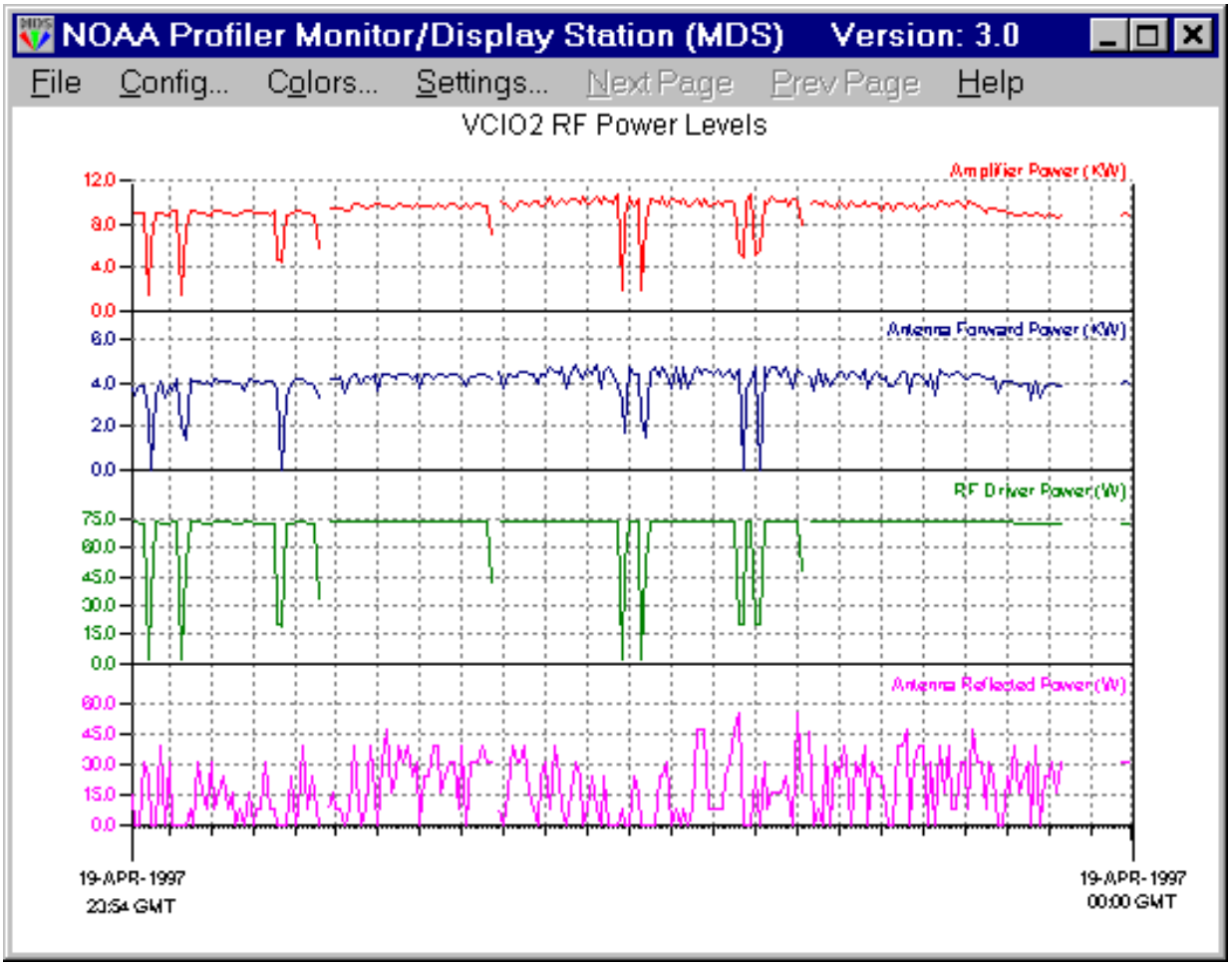
Receiver Noise Levels



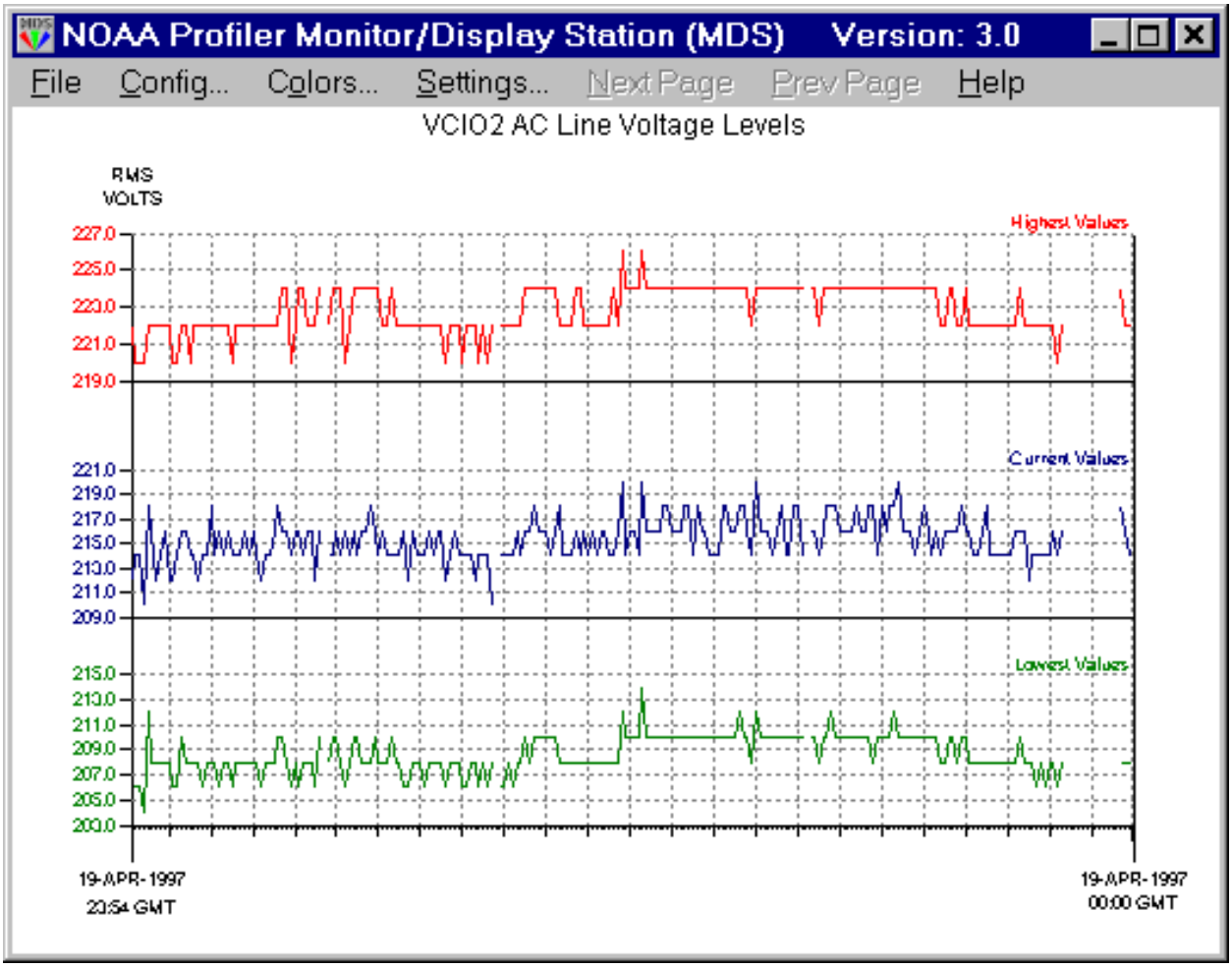
System Noise



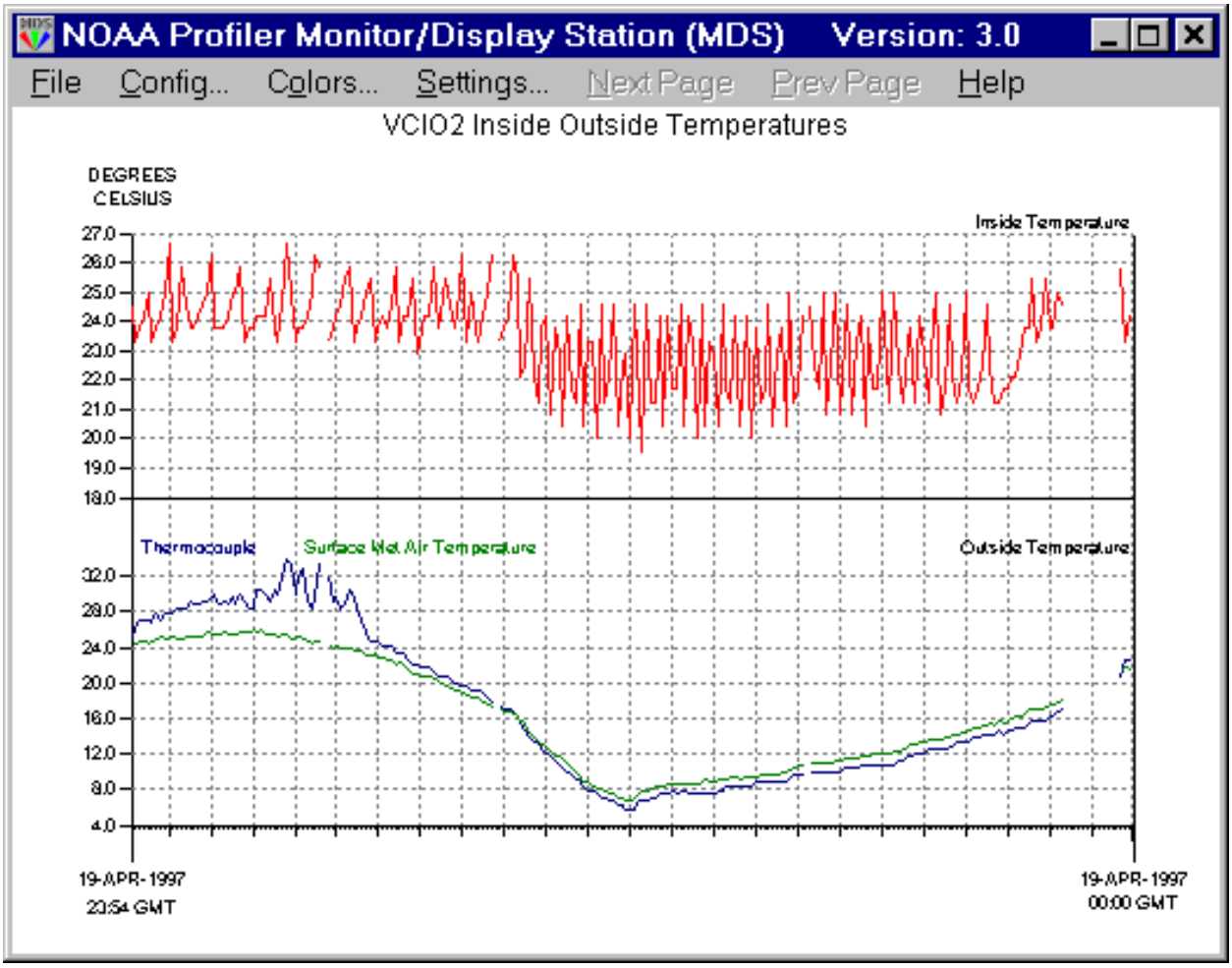
RF Power Levels



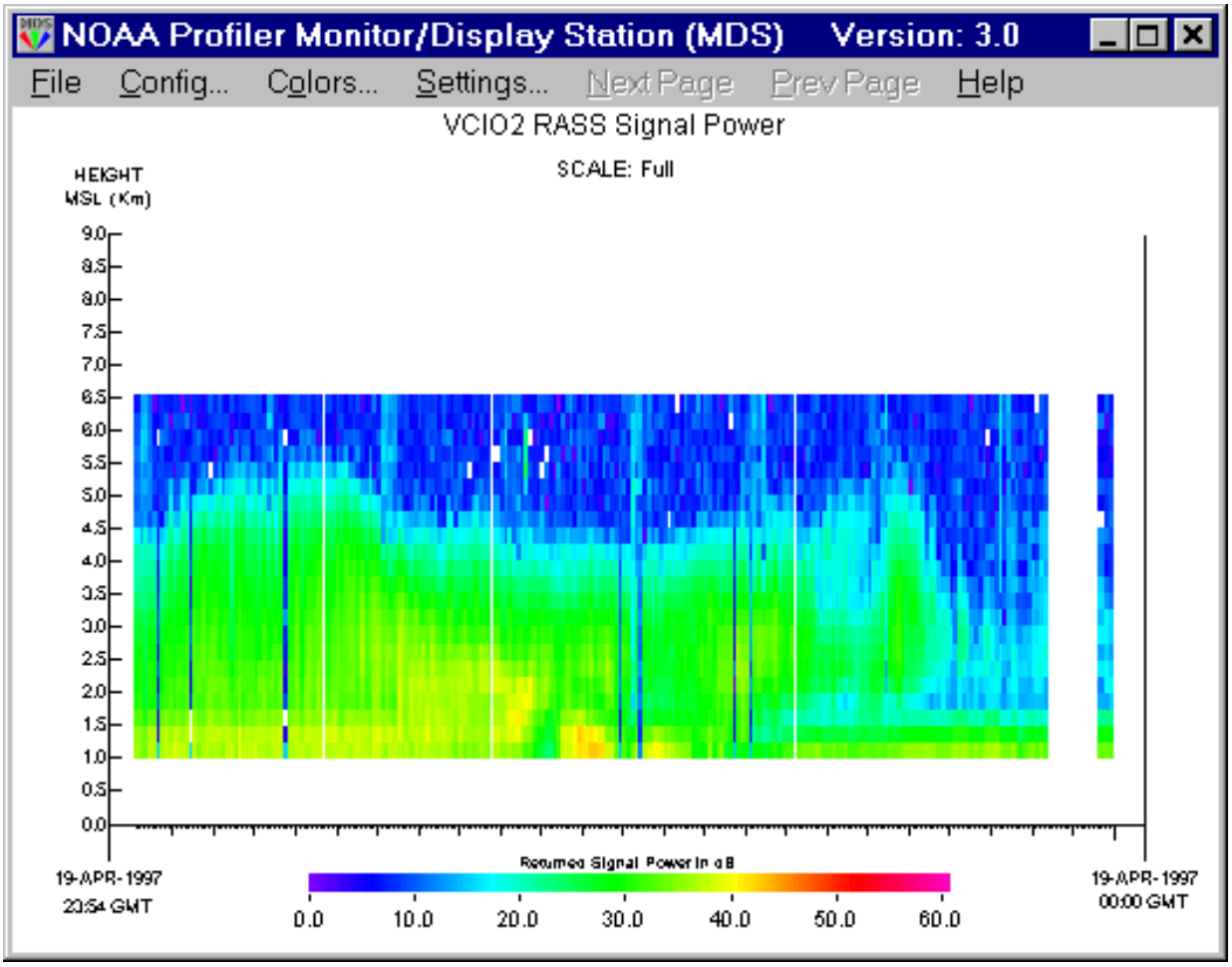
AC Line Voltage Levels



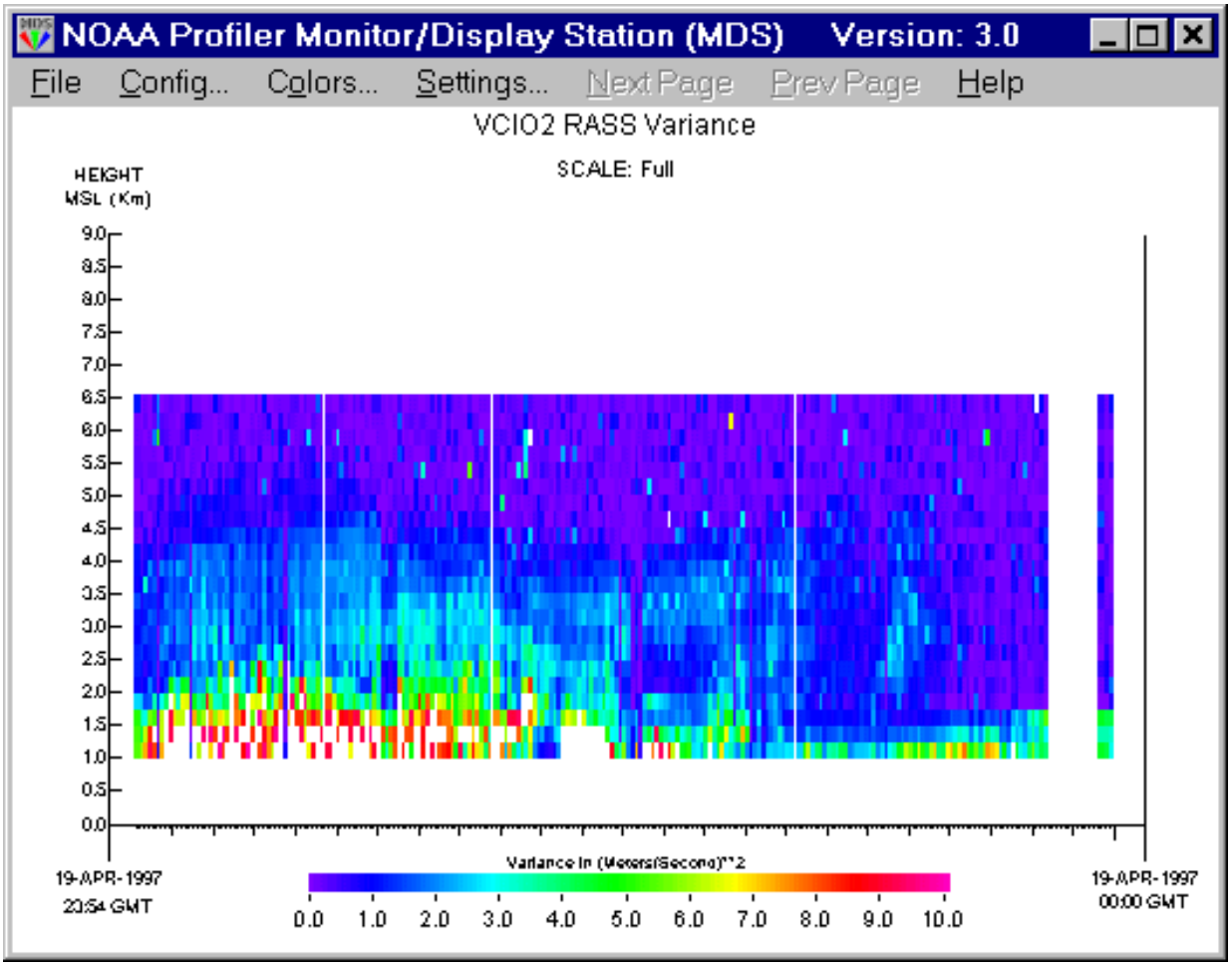
Inside Outside Temperatures



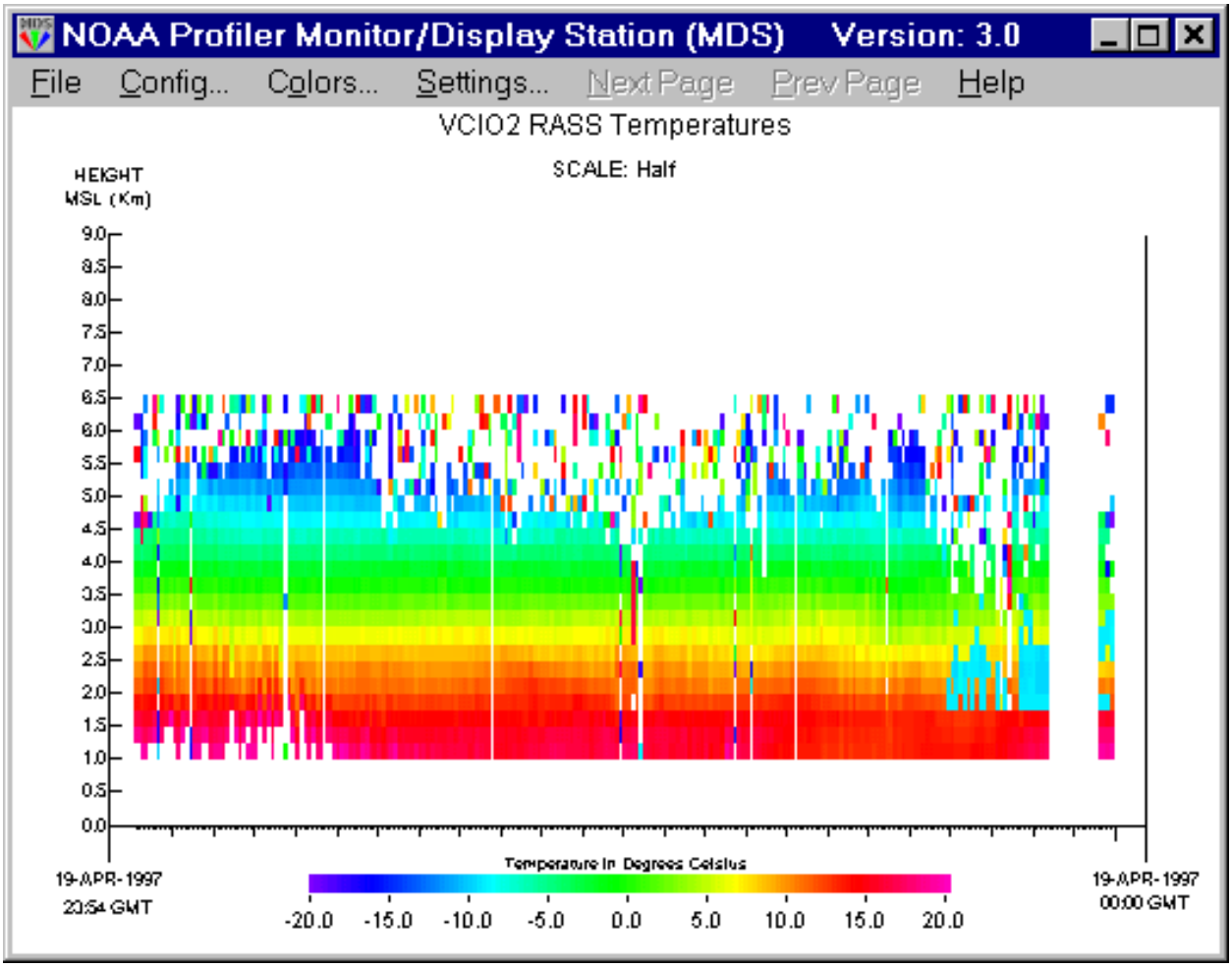
RASS Signal Power



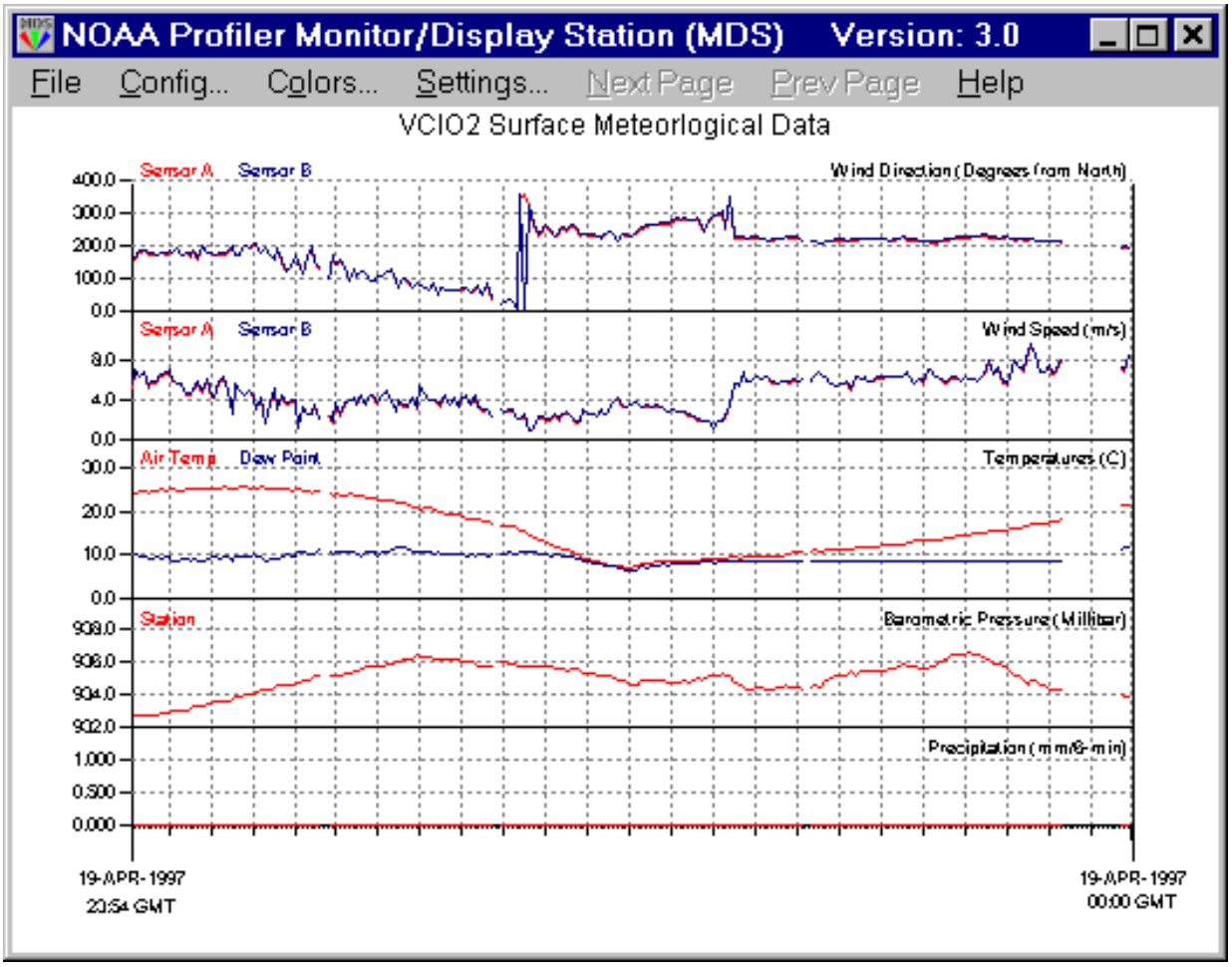
RASS Variance



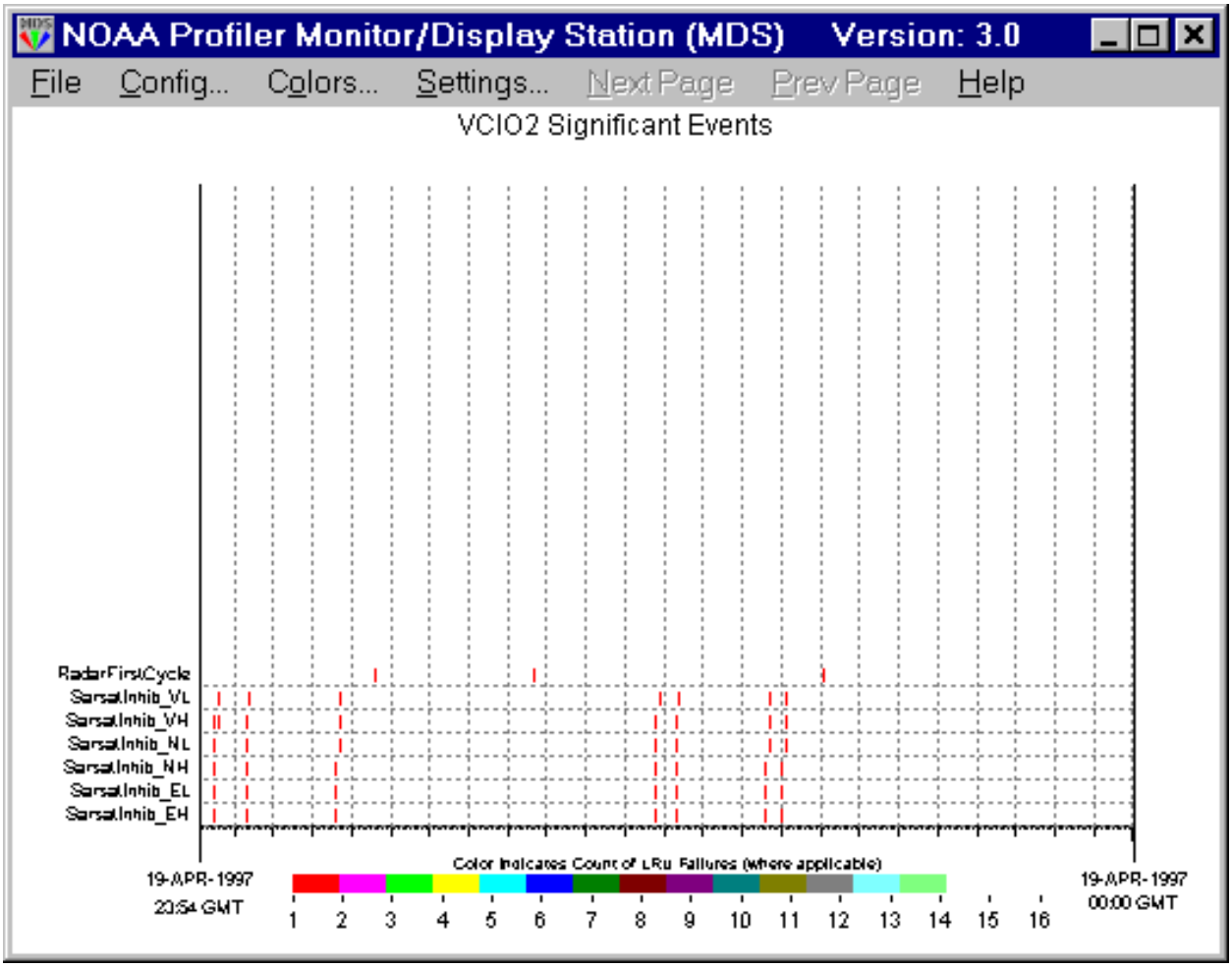
RASS Temperatures



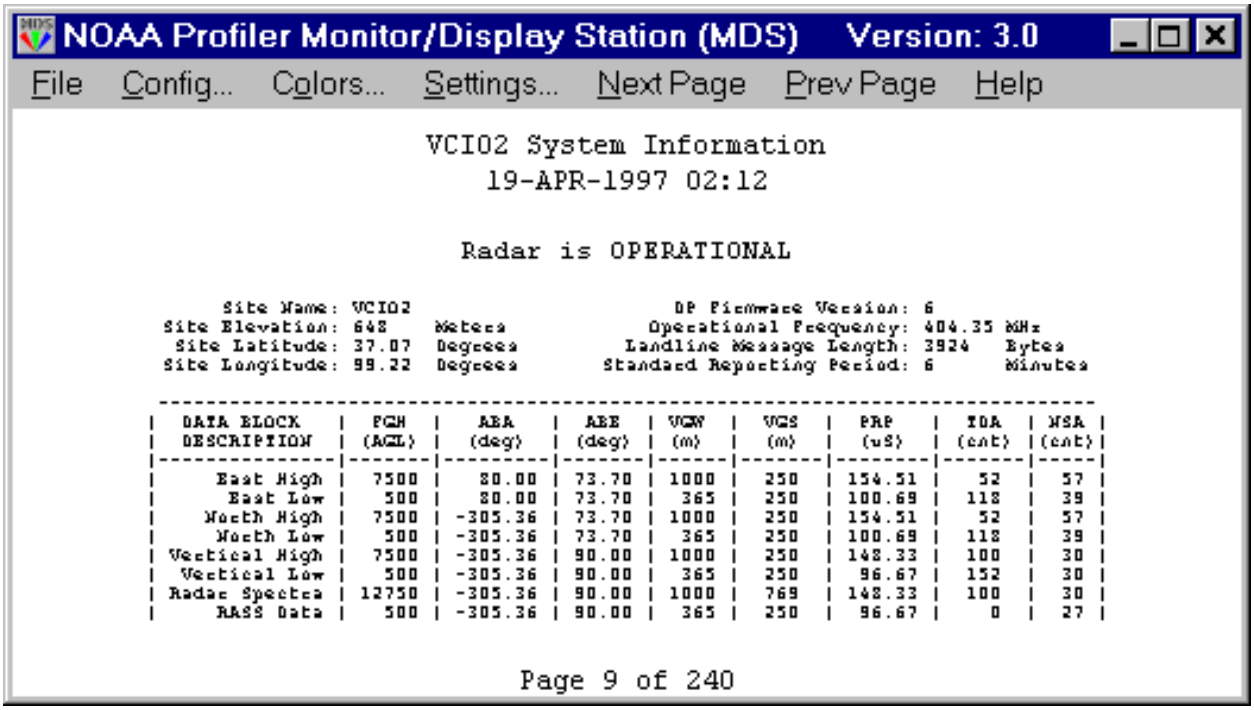
Surface Meteorological Data



Significant Events



System Information



Wind Speed and Direction